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A Study on Factors for Improving CPR based on Health Care Professionals Treating Cardiac Arrests

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Abstract

This study aimed to help build a quality control program to improve cardiac arrest treatment via analysis of medical records in a local tertiary general hospital to evaluate factors that influence clinical outcomes of in-hospital cardiac arrest. At first, the medical records of in-hospital cardiac arrest were analyzed, and targeted surveys about functional and structural factors associated with cardiopulmonary resuscitation (CPR) were conducted amongst the workforce in charge of cardiac arrest treatment. From January 2012 through June 2013, a total of 486 adult cases of in-hospital cardiac arrests, except for those occurring in the emergency room, were enrolled in this study. Among the patients, those of recovery of spontaneous circulation were 57.8%; 13.8% of patients were discharged alive; 8.9% of patients were discharged without significant neurologic sequela. Despite CPR is usually successful when administered as quickly as possible, in this analysis showed that prompt reaction after initial recognition was significantly lower in nurses compared with doctors. Analysis of survey results showed that confidence in performing CPR was significantly associated with the experience of CPR in doctors, while in nurses educational experience showed a correlation. In order to improve quality of in-hospital CPR system maintaining and increasing confidence of CPR performance is the most important factor. Therefore it can be helpful to develop and apply a phased, customized education program using training simulators as well as personalizing them to increase the personnel's confidence in CPR performance.

Key words: *CPR, Cardiac arrest, Patients, Confidence*

1. Introduction

Patient safety is the number one priority in hospitals, and cardiac arrest is a significant issue that accounts for a large proportion of sudden deaths [1]. According to the results of a cardiac arrest survey by the Ministry of Health and Welfare in 2012, among non-public facilities, 2.3% and 8.3% of cardiac arrests occurred in medical institutions and nursing homes, respectively [2], and according to US research data, about one-third of 400,000 cases per year occur in hospitals [3]. In the recent studies, the survival-to-discharge rate of in-

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hospital cardiac arrests was 15%-28.5%, and 30%-65% of those patients showed good neurological prognosis [3-7], but the treatment outcomes showed significant differences depending on the region. A study in the US also reported that the survival-to-discharge rate of out-of-hospital cardiac arrests varied greatly by region due to the differences in treatment at local hospitals [3, 8]. The limited staff of hospitals, lack of training and operating systems, and insufficient equipment or facilities may pose serious problems in treating cardiac arrest patients, and inadequate cardiac arrest treatment can lead to social issues, deterioration of health care quality, and economic losses [9, 10]. Recently, hospitals in Korea have established Clinical Performance Examination(CPR) systems by preparing CPR operation systems, promoting CPR teams, and providing employee education and training programs to meet the purpose and evaluation criteria of the hospital accreditation system introduced in 2009 [11], but more active and systematic cardiac arrest treatment is needed to minimize neurological damage [12]. This is because the goal of CPR has expanded from the return of spontaneous circulation (ROSC) to improved quality of life and functional recovery [13]. To achieve this, it is important to objectively evaluate the people treating cardiac arrest and perform quality management to optimize the CPR system and environment in hospitals [14]. However, most of the previous studies on cardiac arrest survival in hospital settings include a lot of data on emergency rooms outside of hospitals and not much data on the survival rate of patients who received treatment for cardiac arrest in pure hospital settings, and the evaluation of CPR quality management was also unclear.

Therefore, this study investigated the results of cardiac arrest treatment in hospital in Korea, and evaluated the confidence of the workforce performing cardiac arrest treatment to examine the association between each characteristic and how each affects the outcome of cardiac arrest treatment, and evaluated the CPR system and environment of the hospital and compared it with external standards to derive factors for improving CPR.

2. Research Method

2.1. Research Subjects

This study was conducted on a tertiary general hospital in D metropolitan city. First, the medical records of 486 adults aged 18 years or older who received cardiac arrest treatment in the hospital (excluding the ER) for the past 18 months from January 2012 to June 2013 were examined to analyze the outcomes. To investigate and evaluate the function of the healthcare professionals treating cardiac arrest, specialists, medical residents, and nurses working in the intensive care unit (ICU), general ward, and special examination rooms were selected as the subjects of this study. This study was performed after obtaining approval from the Medical Research Ethics Review Committee (approval number: KM 2013-10-032). The researchers submitted a waiver checklist to be exempted from the requirement of obtaining informed consent to analyze the medical records of patients who received cardiac arrest treatment, and explained the purpose of the study and absolute confidentiality to the participants, and obtained written consent before using the collected data. Among the questionnaires filled out by the participants in this study, the number of questionnaires used for the final analysis was 229 copies (doctors: 72, nurses: 157).

2.2. Research Tools

2.2.1. Analysis of Survey Records based on Medical Records:

This study prepared and used CPR survey records based on the 'In-hospital Utstein-style' developed in 1997 to objectively evaluate and compare the treatment effects of cardiac arrest patients in hospitals [15, 16]. The 'In-hospital Utstein-style' is divided into hospital variables, patient variables, arrest variables, and outcome variables, and this study considered the return of spontaneous resuscitation (ROSC) from the arrest variables and patients who survived for more than 31 days, patients who were discharged from hospital, and the cerebral

performance category scale (CPC) from the outcome variables to measure the outcomes of cardiac arrest. CPC is a scale used to measure the degree of brain damage after CPR. In terms of CPC scores, CPC 1 is defined as conscious, alert, and able to work with good cerebral performance, and CPC 2 refers to conscious and alert with moderate cerebral disability (sufficient cerebral function for independent activities of daily life)..

2.2.2. Analyzing the Confidence of Doctors and Nurses Performing CPR:

In this study, confidence refers to the ability to perform one's role competently in cardiac arrest situations, and it was evaluated by the self-assessment of doctors and nurses. The doctors answered a total of 18 questions, 8 questions to measure their competency as a leader, and 10 questions to measure their competency as a team member. The nurses answered a total of 29 questions, 13 questions about before the CPR team arrives, 12 questions about after joining the CPR team, and 4 questions about after performing CPR. Each question uses a 5-point Likert scale, and the higher the score, the higher the competency. In this study, the Cronbach's α for the doctor and nurse group was .927 and .915, respectively.

2.3. Data Analysis and Statistical Processing:

The SPSS/WIN 22.0 Program was used to analyze the collected data. The general characteristics and measurement variables of the subjects were analyzed by frequency, percentage, mean, and standard deviation, and Cronbach's α was used to measure the reliability of the measurement tools. Cross-analysis and variance analysis between measurement variables was performed by chi-square test, the correlation between measurement variables was verified by Pearson correlation coefficient, and the level of statistical significance was $p < 0.05$.

3. Research Results

3.1. Analysis of Cardiac Arrest Patients' Records:

The medical records of 486 adults aged 18 years or older of in-hospital cardiac arrests from January 2012 to June 2013 were analyzed, except for those that occurred in the emergency room.

3.1.1. General Characteristics of Cardiac Arrest Patients and Treatment Outcomes

As a result of analyzing the medical records of 486 cases of in-hospital cardiac arrests, 296 (60.9%) of the patients were males, the average age was 66.6 years (±12.9). In terms of the department, 351 (72.2%) cases occurred in internal medicine, 44 (9.1%) in neurosurgery, 40 (8.4%) in surgery, and 15 (3.1%) in thoracic surgery, and 296 cases (60.9%) occurred in the ICU. In terms of outcomes, there were 281 (57.8%) cases of ROSC, 87 (17.9%) cases who survived for more than 31 days, 67 (13.8%) cases who were discharged from the hospital, of which 43 (8.9%) were discharged with a CPC score of 1 or 2.

3.1.2. The First Witness and Responder of CPR According to The Place of Occurrence:

In this study, the first witness refers to the person who first witnessed cardiac arrests in an operational sense, and the first responder refers to the person who performed CPR starting with chest compressions. When dividing the place of occurrence into the ICU and other locations, 132 cases (44.6%) and 163 cases (55.1%) were first witnessed by doctors and nurses in the ICU, respectively, but the first responders who performed CPR were 229 doctors (77.4%) and 66 nurses (22.3%). In places other than the ICU, 46 cases (24.2%) and 139 cases (73.2%) were first witnessed by doctors and nurses, respectively, but the first responders were 125 doctors (65.8%) and 65 nurses (34.2%). Therefore, 354 doctors (73%) and 131 nurses (27%) actively

performed CPR according to their occupation, showing that prompt reaction after witnessing cardiac arrests was significantly lower in nurses than doctors.

3.1.3. Differences in ROSC of Cardiac Arrest Patients According to The Place of Occurrence:

There was no significant difference in the ROSC of cardiac arrest patients according to the place of occurrence. Table 1

Table 1. Differences in ROSC of cardiac arrest patients according to the place of occurrence

Location	Reason for stopping CPR_ROSC		chi-square	p-value
	ROSC(+) n(%)	ROSC(-) n(%)		
ICU (n=190)	111(58.4)	79(41.6)	0.046	NS
Other than ICU (n=296)	170(57.4)	126(42.6)		

ICU: intensive care unit; NS: not significant; ROSC: return of spontaneous resuscitation; ROSC(+): Stopped CPR due to ROSC; ROSC(-): Stopped CPR for reasons other than ROSC

3.2. Confidence of People Performing Cardiac Arrest Treatment

3.2.1. The Confidence of Doctors Performing CPR:

Table 2 shows the mean and standard deviation of the doctors' confidence in performing CPR. In terms of the department, the confidence in performing CPR was high in the order of emergency medicine (4.59 ± 0.52), thoracic surgery (4.57 ± 0.28), neurosurgery (4.01 ± 0.63), surgery (3.82 ± 0.54), internal medicine (3.65 ± 0.61), and pediatrics and adolescents (3.64 ± 0.49). Based on the mean (3.91 ± 0.66), their confidence as a leader performing CPR was generally low, and their confidence as a team member was low in preparation for hypothermia therapy (3.08 ± 1.23) and CPR records (3.75 ± 0.98). Table 2

Table 2. Confidence of doctors performing CPR

	Item	Department							p-value
		Internal medicine	Surgery	Pediatrics	Emergency medicine	Thoracic surgery	Neurosurgery	Total	
Confid-ence	Total	3.65±0.61	3.82±0.54	3.64±0.49	4.59±0.52	4.57±0.28	4.01±0.63	3.91±0.66	<0.001

NS: not significant; Items: See Appendix 1

3.2.2. The Confidence of Nurses Performing CPR:

Table 3 shows the mean and standard deviation of the nurses' confidence in performing CPR. When dividing the workplace in the ICU and other places (4.11 ± 0.55), the nurses in the ICU (4.11 ± 0.55) were more confident than those working in other places (3.75 ± 0.73). Based on the mean (3.85 ± 0.7), the nurses' confidence before the CPR team arrives was generally low in the items related to defibrillation treatment. In terms of after joining the CPR team, the nurses' confidence was low in constructive interventions in communication (3.57 ± 0.98) and explaining the situation and controlling the patients' family (3.54 ± 0.95),

and their confidence was low in terms of CPR records (3.75 ± 0.98), emotional support for the patients' family (3.48 ± 0.95), and preparation for hypothermia therapy (2.79 ± 1.15) after ending CPR. **Table 3**

Table 3. Confidence of nurses performing CPR

Confidence Item	ICU	Non-ICU	Total	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Total	4.11 ± 0.55	3.75 ± 0.73	3.85 ± 0.70	<0.001

ICU: intensive care unit

3.2.3. Differences in The Doctors' Confidence in Performing CPR According to Experience and Education:

Table 4 shows the correlations between the doctors' confidence in performing CPR according to experience and education or training. The doctors with experience were more confident in performing CPR, but there was no significant difference between their experiences in CPR training. **Table4**

Table 4. Doctors' confidence in performing CPR according to experience and education

Confidence Item	Experience performing CPR			Education		
	Experience	Mean ± SD	p-value	Experience	Mean ± SD	p-value
Total	O	3.99 ± 0.69	<0.05	O	4.03 ± 0.73	NS
	X	3.68 ± 0.50		X	3.77 ± 0.55	

NS: not significant

3.2.4. Differences in The Nurses' Confidence in Performing CPR According to Experience and Education:

Table 5 shows the correlations between the nurses' confidence in performing CPR according to experience and education. The nurses who received CPR training were more confident in performing CPR, but there was no significant difference between their experiences in performing CPR**. Table 5**

Table 5. Nurses' confidence in performing CPR according to experience and education

Confidence Item	Experience performing CPR			Education		
	Experience	Mean ± SD	p-value	Experience	Mean ± SD	p-value
Total	O	3.88 ± 0.69	NS	O	3.70 ± 0.79	<0.05
	X	3.79 ± 0.71		X	3.95 ± 0.62	

NS: not significant

3.3 The Burden of Cardiac Arrest Situations between Occupations:

Table 6 shows the burden of doctors and nurses performing CPR according to cardiac arrest situations. Nineteen out of 72 (26%) doctors and 132 out of 157 (84%) nurses said that they felt the burden of performing CPR, indicating that nurses felt more burden and fear of being exposed to CPR environments. **Table 6**

Table 6. The burden of cardiac arrest situations between occupations

Occupation	Burden		chi-square	p-value
	O n(%)	X n(%)		
Doctors (n=72)	19(26)	53(74)	73.14	<0.001
Nurses (n=157)	132(84)	25(16)		

4. Discussion

This study investigated the status of cardiac arrest treatment at a tertiary general hospital in Korea, and analyzed the confidence and burden of healthcare professionals performing CPR that affect cardiac arrest treatment.

First, as a result of analyzing the survey records of cardiac arrest cases, there was no difference in the ROSC of cardiac arrest patients depending on whether they were found in the ICU or places other than the ICU. There was also no difference according to whether the first responder who performed CPR was a doctor or a nurse, but in the case of nurses, there were significantly more first witnesses (302, 62.1%) compared to first responders (131, 27%), indicating that nurses less actively performed CPR in cardiac arrest situations. According to the results of analyzing the confidence and burden of people performing CPR, nurses felt more burden than doctors, so the first witnesses failing to become the first responders may be due to the lack of confidence in performing CPR [17-19]. According to previous studies, nurses do not actively perform CPR due to factors, such as their knowledge, attitudes, and educational benefits related to CPR [20-22]. In this study, the nurses' confidence was also related to their educational experience. The role of nurses who first witness most of the cardiac arrests in hospitals is very important because the treatment from cardiac arrest to integrated therapy needs to be connected quickly and organically for cardiac arrest patients to survive [13]. In other countries, the survival rate of cardiac arrest patients was four times higher when nurses who received ACLS training started CPR compared to nurses who did not receive such training [23], and they also effective in CPR as much as doctors who received ACLS training [24]. A study by Abella et al. [25] reported that simulation equipment and educational programs are essential for CPR education and training. In light of these facts, it is judged that the confidence of nurses performing CPR can be improved by applying the ACLS curriculum of the American Heart Association or the KALS curriculum, which has been operated since 2011 in Korea, and enhancing case-oriented training by using simulators.

Second, as a result of analyzing the confidence of healthcare professionals performing CPR, the doctors' confidence was associated with their experience in performing CPR. In this study, emergency medicine doctors showed the most confidence in performing CPR. Previous studies reported that emergency medicine doctors experienced more cardiac arrest situations and received more training [26], and that the patients who received cardiac arrest treatment from CPR teams composed of emergency medicine doctors showed good neurological prognosis after being discharged from the hospital [27]. This study also showed that the emergency medicine doctors were significantly more confident in preparing and implementing hypothermia treatment, which is part of integrated therapy after cardiac arrests, compared to other clinical departments. The goal of cardiac arrest treatment is to optimize tissue perfusion, restore metabolic homeostasis, and minimize nerve damage to increase the qualitative survival rate [28], so doctors need to have a full understanding of integrated therapy after cardiac arrest and hypothermia therapy for a better neurological prognosis [29-32]. Therefore, clinical departments with a high incidence of cardiac arrest need to actively implement various methods to estimate

the prognosis of patients after cardiac arrest and evaluate the strengths and weaknesses of such methods. In the case of nurses, there was no difference in confidence according to their experience in performing CPR, but there was a difference according to their educational experience. In the case of general hospitals, since doctors are more likely to perform CPR, most nurses had no experience in performing CPR, so there was no significant difference according to experience. However, many medical institutions currently provide professional CPR training for nurses and emphasize individual and group training, so educational experience showed a difference in confidence among these nurses.

Recently, a large medical institution in Korea reorganized its CPR team and reinforced CPR training for all employees in 2007, and reached a 28.5% survival-to-discharge rate in 2009 [27]. Therefore, more efforts are needed to improve the survival rate by expanding the employees' experience in clinical settings and providing educational experience using simulations. In addition, long-term prognosis, or a survival-to-discharge rate with less neurological damage [33], is the most important variable for cardiac arrest, so it is necessary to convert to a cardiac arrest prevention-centered system to actively manage information and measure the risk of heart disease, stroke, and severe diseases in the future. This can only be achieved on the premise of hospital management and employees joining efforts [34].

4. Conclusion

This study aimed to help build a quality control program to improve cardiac arrest treatment via analysis of medical records in a local tertiary general hospital to evaluate factors that influence clinical outcomes of in-hospital cardiac arrest. In order to improve quality of in-hospital CPR system maintaining and increasing confidence of CPR performance is the most important factor. Therefore it can be helpful to develop and apply a phased, customized education program using training simulators as well as personalizing them to increase the personnel's confidence in CPR performance. The limitations of this study are as follows. The results cannot be generalized because the subjects were sampled from one medical institution and do not include all of the hospitals in Korea. Therefore, it is necessary to increase the number of samples to obtain more reliable research results. In addition, the confidence in performing CPR was measured by the results of a self-reporting test, so experimental studies should also be performed by subdividing and evaluating the process of performing CPR, in addition to using self-reporting questionnaires, to conduct more accurate research.

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